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FOOD AND ECONOMIC RELATIONS OF NORTH AMERICAN GREBES.

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INTRODUCTION.

A knowledge of the feeding habits and general economic status of the species of grebes inhabiting the different sections of the United States is of importance in connection with the relations of these birds to the supply of food fishes. Living in ponds, lakes, and watercourses, grebes have at times been suspected of being seriously detrimental to the continuance of certain valuable fishes. That this suspicion is without actual foundation in fact has been ascertained in the investigations reported upon in this bulletin.

DISTRIBUTION AND HABITS OF GREBES.

Six species of grebes are found in North America north of the Isthmus of Panama, all of them ranging within the limits of the United States. These birds breed in the interior, but during their migrations are found on salt water along our coasts as well as on open ponds and streams throughout the country. Their almost supernatural powers of diving to escape a shot are common knowledge among hunters, from the boy armed with a small-bore rifle to

[1] Prepared by the author when a member of the present Division of Food Habits Research.

NOTE.—This bulletin presents a detailed study of the food and feeding habits of the six species of grebes that occur in the United States. It will serve as an index to the economic status of these birds, and will be useful to naturalists, sportsmen, conservationists, and others interested in waterfowl.

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the sportsman with heavier equipment, and have earned for grebes the common appellations of water-witch, hell-diver, and didapper. In diving suddenly grebes spring forward and disappear head foremost, moving so quickly as to be below the surface before a charge of shot can reach them. When not alarmed grebes often sink slowly beneath the surface, and may remain for some time with only the head projecting, maintaining their position through a lateral, rotary motion of the strong, broadly lobed feet.

Under normal conditions grebes are quiet birds, spending their time during most of the year, when not feeding, in swimming slowly about, resting quietly, or in preening and caring for their plumage. During the breeding period they become more active and exhibit many pleasing habits and mannerisms unsuspected from their demeanor at other seasons. Several species have a peculiar "dance" in which both birds, treading water and calling excitedly, stand bolt upright on the surface in an attitude resembling miniature penguins.

DESCRIPTION.

The entire form of grebes has been modified in adaptation to their watery habitat. The body is long, rather slender, and compressed, the plumage close and dense, wholly impervious to moisture, and the strong, heavy legs are at practically the posterior end of the body. The apparent position of the legs is accentuated by the form of the tail, which is represented by only a few filamentous feathers, so that, save on close examination, it appears to be absent.

The wings are short, and small in surface compared to the weight of the body, so that grebes prefer to trust to their marvelous agility in diving to escape pursuit rather than attempt to fly. When flight is necessary the birds rise in the air only after gaining momentum by paddling with swiftly moving wings and feet for a hundred yards or more along the surface of the water. When in the air they have a direct, strongly sustained flight which carries them for long distances during their extended spring and fall migrations. In diving, grebes usually hold the wings in closed position at the sides, but they have also been observed to use them in swimming under water.

NESTS, EGGS, AND YOUNG.

The nests of grebes are made of masses of decaying vegetation piled up in shallow water to form a mound that barely projects above the surface. The eggs, laid in a depression on the summit of this heap, lie almost in the water; they are often passed unnoted, as the female invariably covers them carefully with some of the nest material before leaving, unless frightened away by the sudden appearance of an intruder.

On hatching, the down-covered young birds swim readily, with the foreneck and breast submerged, so that only the head and posterior portion of the back project above the water. They tire easily, however, and with plaintive whistles approach the mother, who depresses her back, allowing the young to scramble up on this living raft, where they take refuge under the long inner feathers of her wings while she swims slowly away. (See fig. 4, p. 19.) In a few days the young become more expert in the water and hide

among the growths of aquatic vegetation, so that until they are at least two-thirds grown it is difficult to observe them. After the young are well grown, the adults disappear for a time in order to molt, resorting for the purpose to dense growths of rushes, where they remain in seclusion for a period of three or four weeks. Like ducks and geese, they shed all the wing feathers simultaneously and are then unable to fly.

ECONOMIC RELATIONS.

The food of the grebes, as would be expected, is made up largely of aquatic organisms belonging to a variety of groups. Of these, fishes are perhaps of greatest importance in establishing the economic status of these peculiar birds. The western and Holboell grebes, the largest of the six forms of the family found within our limits, take more fishes than do the smaller species, but on the whole they can not be considered actually injurious, as the kinds eaten are in most cases of little or no value to man.

From the basis of the present studies it can not be said that any species of grebe is directly inimical to the fishing industry. Grebes which alight during migration in ponds at fish hatcheries may do serious damage, and in such places it is advisable to drive them away or destroy them if Federal and State laws permit.[2] This stricture applies in the main, however, to only one species, the pied-billed grebe, as only occasionally do the other forms appear in such localities. The sacrifice of the few pied-billed grebes which it may be necessary to kill for this reason can have little or no effect upon the abundance of these widely distributed birds.

With the exception of the large western grebe (which so far as known at present feeds only upon fishes), all of our grebes feed extensively upon crustaceans, and when more material is available for study it is possible that this species also may be found to eat this kind of food. The Holboell grebe takes many marine crustaceans, as do the horned and eared grebes. The two last mentioned and the pied-billed grebe destroy also many crawfishes. The feeding of the pied-billed grebe is especially beneficial in this manner in localities where crawfishes are destructive to crops.

Aquatic Coleoptera (beetles) and Heteroptera (bugs) figure largely in the food of the smaller grebes, and that of the pied-billed grebe shows that the birds prey extensively upon giant water-bugs and predacious water beetles, insects that are reputed to be seriously destructive at times to the small fry of fishes. Eared and horned grebes in summer often act the part of scavenger in feeding upon the masses of miscellaneous insects found floating on the water. During the flights that occur as these forms emerge in the adult state, frequently bays and ponds are covered with the bodies of such of these creatures as have attempted to alight, only to be entrapped by the water and drowned. From this source these grebes secure a greatly varied insect fare, but one, however, of no particular economic significance.

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[2] For a summary of the provisions of Federal, State, and Provincial game laws, see the latest annual Farmers' Bulletin on the subject (that for the season 1923–24, Farmers Bulletin No. 1375, U. S. Department of Agriculture).

FEATHER EATING.

All of our species of grebes have the peculiar habit of eating quantities of their own feathers, masses of which were found in practically every stomach opened. This fact has been recognized by naturalists for many years, though in numerous instances the feather remains have been mistaken for miscellaneous substances, ranging from the hair of mammals to silky vegetable fibers. Why these feathers are eaten and what part they may play in the economy of the bird are points on which we have no definite knowledge. The feathered covering of grebes is dense and abundant, and the writer on various occasions has observed the birds preening and arranging their plumage. Feathers loosened during this process are sometimes discarded and sometimes dabbled in the water, to be moistened and then swallowed.

The stomach of the grebe has a small accessory chamber (a pyloric lobe) in which the opening into the small intestine is found. This lobe is almost invariably plugged with a ball of feathers, even though feathers are absent in the main chamber.

It is noticed that feathers occur in greatest abundance and most commonly in stomachs containing remains of fishes and hard-bodied insects, and that they are less abundant (or are even occasionally absent) in gizzards containing soft-bodied larvae or crustaceans that are easy of digestion and assimilation. It may be suggested that the feathers act as a strainer to prevent the passage of fish bones or large fragments of chitin into the intestine until they have been reduced to a proper size and condition by the process of digestion. In this way injury to the intestinal walls from these hard fragments may be avoided.

Whatever the use of feathers, they can not be held to have any considerable food value, even though they are constantly ground up and passed on into the intestinal tract. In the accounts of the individual species, therefore, though the presence of feathers in these stomachs has in each case been estimated as a matter of interest, this item has been discarded before the actual food content is apportioned on the basis of 100 per cent.

PROTECTED STATUS.

Prior to 1903 many thousands of grebes were killed by hunters for the sake of their beautiful breast feathers, which attracted attention in commerce. The western grebe especially suffered heavily from the whim of feminine fashion, as this species, like the eared grebe, congregated in large colonies during the breeding season. Held to one locality by the instinct that drew them to their nests and young, the birds were slaughtered in these colonies with ease until their numbers were greatly reduced. One hunter in Oregon told of killing 135 grebes on one occasion, and on the large shallow lakes in the Great Basin region many thousands in all were shot for their skins. Fortunately, in 1903 the market for grebe skins was closed, and slaughter by professional hunters practically ceased. With increased protection during recent years the birds have regained something of their former abundance.

A serious factor affecting grebes, as well as many other species of water birds, is the reclamation of extensive marshes and shallow

lakes in the West, projects which have reduced the areas where these birds may find suitable breeding grounds. As grebes are not considered game and are thus protected by Federal law at all seasons, they should maintain their present numbers.

Although the meat of the grebe is edible if properly prepared, it is relatively small in quantity and is not of the best quality. The bulk of it is found on the strong thighs and legs, where in adult birds the muscles are quite likely to be tough and stringy. When cooked, the flesh is very dark and at times is unpleasant in taste and odor, so that it does not meet with general favor.

WESTERN GREBE.

(*Aechmophorus occidentalis.*)

The western grebe, the largest member of its family found in North American waters, ranges in the western portion of the continent,

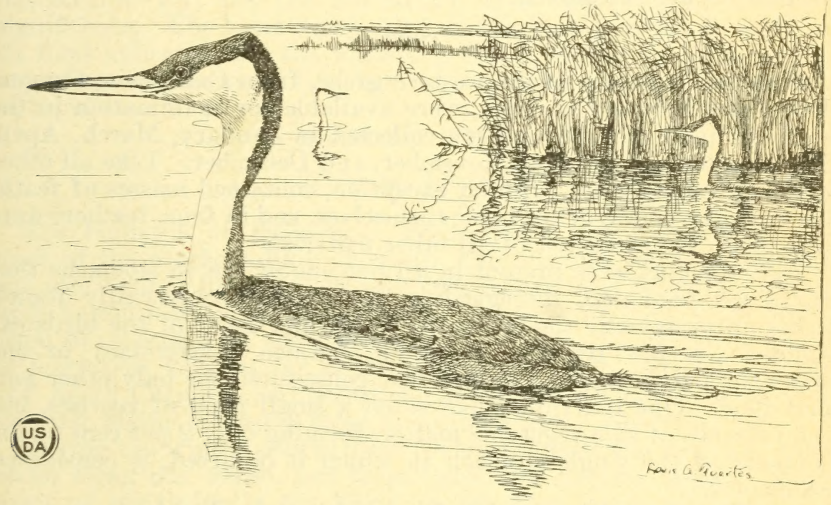

FIG. 1.—Western grebe.

where it breeds from British Columbia and Manitoba south to northern California, Utah, and North Dakota. During the winter season a part of these birds remain in the North wherever there is sufficient open water for their needs, but others at this time extend their range as far south as the State of Jalisco in central Mexico. Western grebes are found on the larger rivers and lakes, and in the summer season frequent the great marshy, tule-grown lakes common throughout their breeding range. In winter they often occur on the ocean or on salt-water lagoons and bays.

The large body, long slender neck, and elongate, sharp-pointed bill serve to distinguish these grebes from any of the other diving birds found in company with them. (See fig. 1.) To these characters may be added a dark gray or blackish coloration above and pure snowy white beneath, with a brilliant red eye, which may be noted upon close approach.

Like other grebes, the present species usually depends upon its skill in diving to escape pursuers, but when encountered in shallow channels choked with growths of aquatic vegetation it occasionally takes wing, when with long neck and large feet outstretched, and on small, rapidly beating wings, it presents a most curious appearance.

Western grebes nest in colonies, building up large, rounded piles of aquatic vegetation to form mounds that barely project from the water. The eggs, usually two or three in number (sets of five are reported), are laid in a slight depression on the top of this mass. The down-covered gray young take to the water as soon as hatched and swim readily with the fore part of the body submerged. When tired they clamber upon the mother's back under her arching wings, and are carried along with their heads projecting through her feathers.

The loud, stirring calls of the adults, one of the pleasant sounds of the great western marshes, come to mind whenever the birds themselves are considered.

FOOD.

Nineteen stomachs of the western grebe, from California, Oregon, Utah, and British Columbia, were available for examination in the study of its food. These were collected in January, March, April, May, September, October, November, and December. Like all other grebe stomachs, these, without exception, contained masses of feathers from the bodies of the birds themselves, and in four, feathers were present to the exclusion of all other material.

Fish remains were present in all but one of the 15 stomachs that contained food and, disregarding the feathers universally found, made up practically the entire food (100 per cent) of the birds examined. A few remains of water boatmen (Corixidae) in one stomach, amounting to a mere trace, constituted the only other animal food. One individual had eaten a small mass of rootlets, but the presence of this vegetable matter, forming only 2 per cent of the contents of the single stomach in which it occurred, is considered accidental.

One bird from Okanogan Lake, British Columbia, had eaten two Columbia chubs (*Mylocheilus caurinus*) about 5 inches long. These fishes are said to frequent the spawning beds of salmon in order to devour their eggs. Another individual had eaten two other small fishes belonging to the same family, the carps (Cyprinidae), but these were too far advanced in digestion to allow more certain identification. A bird taken near the mouth of Bear River, Utah, had eaten two small carp (*Cyprinus carpio*) and a sucker known locally as "mullet" (*Catostomus ardens*). Another stomach from the same locality contained four small carp entire and the remains of four more, while in a third were four chubs (*Leuciscus lineatus*), one of which was 4½ inches long.

A grebe from Netarts Bay, Oreg., contained fragments of seven or more little smelts (*Atherinops affinis*), and another from near Wilmington, Calif., had eaten a small California smelt (*Atherinopsis californiensis*). Both of these fishes occur in large schools in shallow bays, and when grown have some value as human food. What few of the small fry are eaten by western grebes can have no particular

economic significance, as these small fishes are present in great schools and the grebes are few in number. Other stomachs contained merely a few bones of fishes that were too far advanced in digestion to be identified. J. Macoun, of the Canadian Geological Survey, has reported finding a large salamander (*Ambystoma*) in the stomach of one of these birds.

SUMMARY.

The material available is scanty, but seems to show that the western grebe depends almost entirely upon fishes as a source of food. Those taken, however, are seemingly of little importance. The species inhabiting the streams and shallow lakes upon which this grebe has its summer home are, as a rule, of little economic value. In other regions the grebes do not occur in sufficient numbers to make them a factor of any moment in the continuance or abundance of any species of food fish. Their feeding is confined to the numerous smaller fry, and the destruction of a few is of no economic significance. The brief survey that it has been possible to make of its food indicates that the western grebe is worthy of protection as an interesting form of life, having no traits that may be marked as injurious.

HOLBOELL GREBE.

(*Colymbus holboelli.*)

The Holboell, or red-necked, grebe has a range extending over most of the northern part of North America and eastern Asia. In our continent it breeds from northern Alaska and Ungava (Northwest Territories) south to the northern border of the United States from Washington to southwestern Minnesota. In winter it passes in migration south as far as California, Colorado, the Ohio Valley, and North Carolina, and occurs north to British Columbia, Wisconsin, and Maine wherever there is suitable water free from ice.

During the winter season these grebes frequent the bays and open ocean along our coasts, and large lakes and streams inland. Their habit of remaining in the North on the open water of large lakes during winter often leads to their destruction, as many cases are known in which the birds have been caught during severe weather and frozen into the ice. Grebes usually are unable to rise in flight from a hard surface, and require a considerable start in order to gain momentum for flight from the water. When caught by encroaching ice, therefore, they may be unable to escape unless they chance upon a permanent air hole, where they may live until the return of milder weather.

On their breeding grounds the Holboell grebes are reputed to be very shy, and, though found in the open during much of the remainder of the year, they are perhaps as little known generally as any of our grebes except the pygmy Mexican grebe, which barely enters our boundaries from Mexico.

FOOD.

The material available for the detailed study of the food of this bird consists of 46 stomachs, representing all the months of the year

but June. These were collected in British Columbia, Alberta, Oregon, North Dakota, Wisconsin, Michigan, Pennsylvania, New York, Connecticut, Massachusetts, and North Carolina. The months of September, October, and November are best represented, while for the summer season there is very little material.

All the stomachs of the Holboell grebes examined contained feathers from the birds themselves, and in 10, feathers alone composed the contents. (See fig. 2.) In tabulating the food items it was found that in the remaining 36 stomachs feathers made up 70 per cent of the total. Although these feathers are ground up and passed out through the intestine, they are not considered as having a distinct nutritive value, as is explained in the introductory paragraphs of

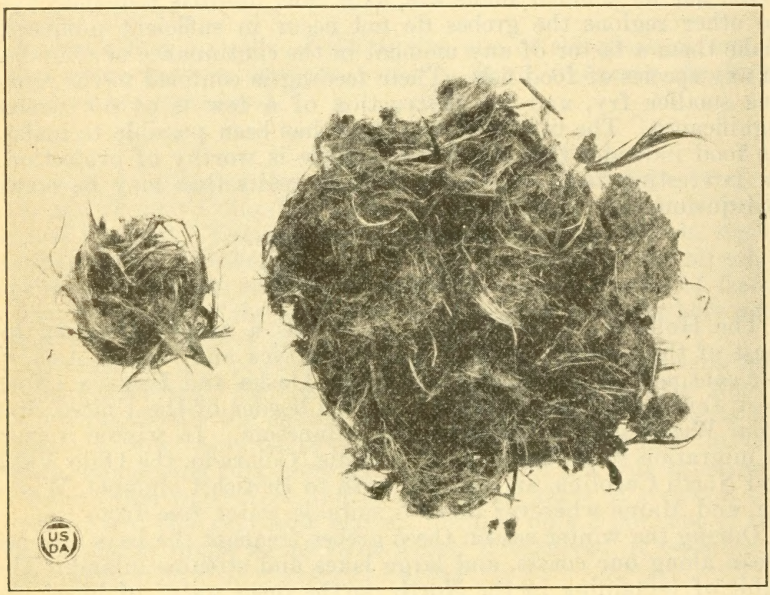

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FIG. 2.—Stomach contents of the Holboell grebe (*Colymbus holboelli*), showing the large numbers of feathers normally present in stomachs of grebes. The larger mass comes from the stomach proper, the smaller from the pyloric lobe.

this paper. For this reason they are not considered in the following computation, and the food items remaining are taken as representing 100 per cent. Of this, 97 per cent is animal and 3 per cent vegetable food.

Fish forms the most important single item in the food of the Holboell grebe, as in 36 stomachs it made 55.5 per cent of the total. Fish remains occurred in 23 stomachs, or half the total number examined, and made the sole food items in 14. Two birds taken on Barkley Sound, Vancouver Island, during the winter season had eaten several Alaska sticklebacks (*Gasterosteus cataphractus*), a salt-water species belonging to a family noted for its destructiveness to the spawn and young fry of other fishes. One grebe taken at Nahant,

Mass., in April, had eaten a sculpin (*Myoxocephalus aeneus*), while three others secured near Shelter Island, N. Y., in February and March had eaten, respectively, 2, 14, and 18 fishes of the same species. Another had taken an eel (*Anguilla chrysypa*) and a top minnow of the genus *Fundulus*. Fragments of fishes belonging to the group containing the perches were found in grebes from Okanogan Lake (British Columbia), North Dakota, and Currituck Sound, N. C., while in one other individual were remains of a minnow of the family Cyprinidae. Eleven stomachs contained fragments of bony fishes that were too far along in digestion to be identified.

Crustaceans, found in 9 stomachs, form one-fifth of the total food, or 20 per cent. One bird from near Staten Island, N. Y., taken in March, had eaten 5 mud lobsters (*Upogebia affinis*) with about 50 other stalk-eyed crustaceans, mainly common shrimps (*Crago vulgaris*) and a few prawns (*Palaemonetes vulgaris*). Another from the same locality had 75 per cent of the stomach contents made up of a mass of remains of the common shrimp. A bird from Pennsylvania had taken a crawfish of the genus *Cambarus*, while 4 from Okanogan Lake, British Columbia, had eaten crawfishes of another group, *Potamobius*. Two others contained remains of crustaceans that were not definitely identified.

Insects form 21.5 per cent of the food and occurred in 13 stomachs of the Holboell grebes examined. One bird had eaten many larvae of a caddisfly. Predacious diving beetles, both in the adult and larval stages, were found in 4 stomachs, and a whirligig beetle (*Dineutes*) in 1. One stomach contained several adult dragonflies, another fragments of water boatmen (Corixidae), and still another back-swimmers (*Notonecta*). Water scavenger-beetles (Hydrophilidae) were encountered once. These are all aquatic in habit and might be expected to be the prey of the water-loving grebes. Other miscellaneous food from the group of insects consisted of remains of flies (family Muscidae), wasps, ants, and other Hymenoptera, a stink bug (Pentatomidae), lamellicorn beetles (Scarabaeidae), ground beetles (Carabidae), billbugs (Calandridae), and indeterminate remains of Coleoptera.

Certain of the insect remains were accompanied by bones of small predatory fishes in such a way that it seemed probable that the insects originally had been contained in the stomachs of the fishes, and for this reason they were not estimated as part of the true food of the grebe. In other cases they appeared alone. It is probable that the Holboell grebes secure these miscellaneous insects by picking up individuals floating on the water. An aquatic bird could not be considered as an active enemy of living individuals of these terrestrial species. Other than these insects, a single jaw of a large sea worm (*Nereis*) was the only item of miscellaneous animal food encountered.

Vegetable substances (3 per cent of the total bulk) were found in 4 stomachs. These have no significance as food and may have been secured during the eager chase of active prey or in some cases may have been released from the stomachs of herbivorous fishes during their digestion.

SUMMARY.

From this survey of the food of the Holboell grebe it appears that though fish formed slightly more than half the sustenance of the individuals examined, this fact is of small significance, as the species taken are in the main of little commercial value. These birds have no special predilection for food fishes valuable to man, but are merely in search of something to satisfy hunger, so that to them a sculpin is as valuable as a species considered more edible by man. As these common forms of little worth are found in abundance, they often furnish a ready supply of food. It can not be considered, therefore, that this grebe is in any true sense an enemy of the fishing industry, while it is probable that, when more material is available for the summer months, when the birds are in the shallow fresh-water inland lakes, insects and crustaceans will be found to furnish a much larger proportion of the food than is indicated above.

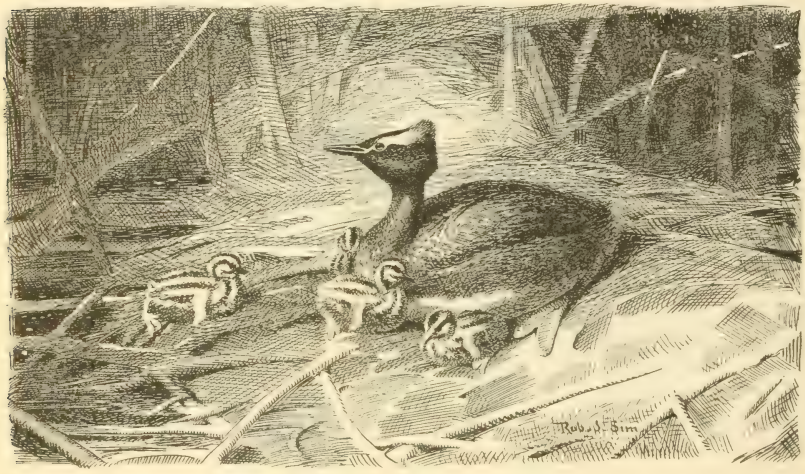

FIG. 3.—Horned grebe. B18831M

A. C. Bent[3] records that at this season in the lakes of Manitoba the birds eat crawfishes, water dogs or salamanders, and aquatic insects.

HORNED GREBE.

(*Colymbus auritus.*)

The horned grebe (fig. 3), a species of wide distribution in the Northern Hemisphere, ranges throughout the whole of the United States and much of Canada. It breeds south as far as the northern portion of the United States and migrates in fall and winter to Florida, Louisiana, and southern California. Winter records from the interior are mainly from the Great Lakes region, as at this season these birds range more commonly along the coasts.

[3] Life histories of North American diving birds, Bull. 107, U. S. Nat. Mus., p. 14, 1919

In breeding plumage the horned grebe has broad, flaring black cheek feathers and lateral crests of yellow. The throat is black, and the lower neck, breast, and sides are rufous. In fall and winter adults and young alike lack the flaring head feathers, being plain dusky above and white below.

Horned grebes are not shy when nesting, but from the nature of their haunts are known at this season to comparatively few. During fall and winter they are more frequently seen, as they are found on open water. Favorable food conditions at times cause them to collect in small flocks, and on our southern coasts it is common to find bands of a dozen or more. Unlike other species, the horned grebes when approached in boats often rise and splatter off across the surface of the water for a hundred yards or more until out of harm's way. If approached a second time they usually disappear beneath the surface. When the water is even moderately rough the birds are unable to gain sufficient momentum to rise on the wing and must perforce take refuge in diving.

FOOD.

For a study of the food of the horned grebe 122 stomachs were available, taken in all months of the year except July. Most of this material, as would be expected, comes from Alaska, Canada, the Great Basin, and the eastern half of the United States, for the species is at its maximum abundance in this region. On the Pacific coast, Alaska, British Columbia, Washington, and Oregon are represented, but there is no material available from California. In this collection 8 stomachs contained feathers alone, and so gave no idea of the food habits of this grebe. In the remaining 114, animal food formed 99 per cent and vegetable matter 1 per cent. In these, feathers from the birds themselves formed 55.5 per cent of the stomach contents, but were not considered as food.

Vegetable food occurred in only six individuals and may be regarded as accidental. It consisted of bits of wood or other rubbish in four instances and occasional seeds of ragweed and stick-tight (*Bidens*) in two others. Sand was found in two stomachs.

Of the animal food, fish remains found in 49 of the 114 stomachs formed 34.6 per cent. In other words, fish occurred in 43 per cent of the total number of stomachs and amounted to one-third of the entire food. With few exceptions the species of fishes identified are of little or no value. The carp (*Cyprinus carpio*), a species used as food but one of tremendous damage to the propagation of fishes much more valuable, occurred once, and other fishes of the same family (Cyprinidae) once. Tessellated darters (*Boleosoma olmstedi*) were eaten by two grebes, and a small eel (*Anguilla*) by another. Fragments of silvery anchovies (*Stolephorus*) and silversides (*Menidia*), both small salt-water species and from their glistening sides known usually as "shiners," were found in two instances.

The Alaska stickleback (*Gasterosteus cataphractus*), a salt-water form ranging from San Francisco Bay northward, was taken by two birds. This fish, known also as the "salmon killer," is locally abundant along the north Pacific coast. In addition to these, the family of sculpins (Cottidae), all of them worthless from the human standpoint, furnished a large part of the fish eaten by the horned grebe.

This was noticeable in particular in specimens secured on the Pacific coast and in those from Okanogan Lake, British Columbia. Among these, fresh-water sculpins (*Cottus*) occurred six times. A peculiar marine sculpin (*Chitonotus pugetensis*) was eaten once, while another member of this family, eaten by one grebe, could not be definitely identified. Fragments of vertebrae or scales of bony fishes that could not be named were found in 30 stomachs, and eggs of fishes were identified in 3. One bird had eaten a fish belonging to the group of perches. This and the eel and carp mentioned above formed the only fishes of any particular commercial value encountered in studying the food of the horned grebe. On the whole, valuable fishes form a small, almost insignificant item in the food.

Crustaceans, found in 29 stomachs, are another important source from which the horned grebe draws a supply of food. Crawfishes, encountered in 8 instances, amount to 10.4 per cent of the total. In 2 cases these belonged to the eastern group of crawfishes (*Cambarus*), which in many places are injurious to various crops. Crawfishes were taken during the months from January to May, inclusive, and in September and October. They are doubtless eaten rather extensively during the summer months also, but the material available is too scanty to show this.

Other crustaceans, eaten by 21 birds, form 7.5 per cent of the total food. The common shrimp, or prawn (*Palaemonetes vulgaris*), a species valuable chiefly as food for various predatory animals, was identified 5 times. The Brazilian prawn (*Penaeus brasiliensis*), a species which in contradiction of its name ranges on our eastern coast north to Cape Cod, was found once, and the sand shrimp (*Crago septemspinosus*) once. A bird from the Pacific coast had eaten another form of shrimp, *Crago franciscorum*, a species common from San Francisco Bay northward, and still another had taken a shrimp of the same genus, but not specifically identified. Shrimps of the last forms are captured in nets and sold in the markets for human consumption.

Following these, isopods, small flattened crustaceans that could not be determined, were found twice, and a sowbug (*Mancasellus*) belonging to the same group, once. A curious form (*Michtheimysis stenolepis*) belonging to the opossum shrimps was eaten once. Though found at times on the surface of the water, these shrimps are more abundant below and may have been secured by diving.

The great group known as the amphipods form a valuable source of food for the horned grebe, as they do also for fishes and other predatory aquatic animals. One species taken (*Chironesimus multiarticulatus*) belongs to a family whose forms are abundantly represented in Arctic waters, where they play the part of scavenger. Any dead animal floating in the water is rapidly eaten up by swarms of these crustaceans.

Other families—Metopidae, Pontogeniidae, and Calliopiidae—usually found floating on the surface of the ocean, were also represented in these grebe stomachs. Sand-fleas (*Gammarus*) and another related species (family Gammaridae) were each taken once. Amphipod remains that were not identified occurred once, and miscellaneous fragments of indeterminate crustaceans six times. Crustaceans other than crawfishes were eaten most commonly in winter,

when the horned grebe frequents salt water. In 18 stomachs secured during the month of December crustaceans form nearly half the food (47.5 per cent).

The insect food of the horned grebe is greatly varied. Beetles alone form 24.4 per cent and other insects 21.6 per cent, so that the two combined equal 46 per cent, or nearly half the fare of this bird. Forms of water-dwelling insects are important food sources and well represented. Water boatmen (Corixidae) were relished apparently, as they occurred 9 times. Back-swimmers (*Notonecta*) were eaten 3 times, a water strider (Gerridae) once, a true water bug (Belostomidae) once, and another small species (*Zaitha*) belonging in the last family, once. Caddisfly larvae were taken 4 times, and the larvae of gnats (Chironomidae) twice. These two often occur in tremendous numbers in western waters. Nymphs of Odonata, in three instances those of damselflies, were eaten 5 times. Mayfly larvae (Ephemeridae) were found once, and other aquatic larvae in 2 cases. Aquatic beetles were well represented in the great mass of insect material. Adult predacious water beetles (Dytiscidae) were taken by 12 birds, and larvae of this same group were eaten by 2. Water scavenger-beetles (Hydrophilidae) were eaten by 15 individuals, and crawling water-beetles (Haliplidae) by 5. These last are of small size, but are frequently eaten in large numbers, as was shown in the case of one bird that had swallowed 190 belonging to 5 distinct species. An aquatic leaf-beetle (*Donacia*) was encountered once.

The insect forms mentioned are of aquatic habits and so are readily available to these grebes. It is highly probable that when more study material is available for the summer months they will be found in much greater numbers, as many of these forms are present in enormous abundance in the inland lakes and ponds on which the horned grebe breeds.

In addition to the insects enumerated thus far, there is another group still to be considered that is secured under somewhat different circumstances. During the warmer months, as the adults of many species of insects emerge for their seasonable activities, they swarm in the air, where they fly abroad or are blown about by the wind. Where chance carries these over water, some, deceived perhaps by the apparent solidity of the surface, attempt to alight, only to remain struggling about and eventually to drown. Frequently bodies of such hapless creatures are strewn thickly about on large water surfaces. This rich food supply is eagerly sought by the grebes, and thus insects of varied groups, which under ordinary circumstances would not be found by a water-haunting bird, come to form an article of its diet. Stink bugs and many ants and miscellaneous Hymenoptera occur among these and with them are found many beetles, including such diverse forms as sap-feeding beetles (Nitidulidae), weevils, and metallic wood-boring beetles (Buprestidae).

Many species of ground beetles (Carabidae) are represented, as are flies, moths, and caterpillars. All of this material represents waste in animal life. Its utilization may be regarded as an adaptation on the part of the grebe that has no particulr economic significance as regards the maintenance or control of the specific forms involved. The grebe simply seizes opportunity as it comes without making special effort to secure the living animals as food, so that it

can not be considered as of value as a control agent, or harmful in destroying insects that may be accounted useful.

Other miscellaneous animal food, amounting to about one-half of 1 per cent, consists of fragments of marine worms (*Nereis*) in two instances, another marine invertebrate in one, and bits of snails in another. Spiders were taken three times.

SUMMARY.

From the above it appears that nearly one-third of the food of the horned grebe is made up of fishes, one-sixth of crustaceans, and approximately one-half of insects. Though fishes form an important item in the diet, especially in the case of birds taken during fall and winter, most of the species eaten are of no particular value for human food. Crawfishes form an important source of food, and in destroying them the horned grebe does a certain amount of good. Some of the shrimps taken are palatable to man, but are not present in great numbers in the grebe stomachs studied. The insects eaten represent varied groups, part of them aquatic in habit and part individuals that by chance have fallen into the water. When these facts are carefully considered, the horned grebe can not be called injurious in any way. As a harmless species it merits protection for the small amount of good it may do in destroying crawfishes.

TABLE 1.—*Items of animal food identified in stomachs of the horned grebe, with the number of times that each occurred.*

ANNULATA (Worms).	
Nereis sp	1
AMPHIPODA (Shrimplets).	
Chironesimus multiarticulatus	1
Calliopiidae	1
Pontogeniidae	1
Metopidae	1
Gammaridae (unidentified)	1
Gammarus sp	1
Unidentified amphipods	2
ISOPODA (Sowbugs).	
Mancasellus sp	1
Unidentified isopods	2
SCHIZOPODA (Opossum Shrimps).	
Michtheimysis stenolepis	1
DECAPODA (Crabs, Shrimps, etc.).	
Palaemonetes vulgaris	5
Crago franciscorum	1
Crago septemspinosus	1
Crago sp	1
Penaeus brasiliensis	1
Cambarus sp	2
Unidentified crawfishes	6
Unidentified crustaceans	6
ANISOPTERA (Dragonflies).	
Nymphs	5
AGNATHA (Mayflies).	
Mayfly larvae	1
ORTHOPTERA (Grasshoppers, etc.).	
Unidentified grasshopper	1
HETEROPTERA (Bugs).	
Euchistus sp	2
Unidentified Pentatomidae	10
Myodocha serripes	1
Reduviolus sp	1
Gerridae	1
Notonecta sp	1
Zaitha sp	1
Unidentified Belostomidae	1
Corixidae	9
Unidentified Heteroptera	7
LEPIDOPTERA (Moths and Butterflies).	
Unidentified moth	1
Unidentified caterpillars	2
COLEOPTERA (Beetles).	
Amara sp	1
Chlaenius sp	1
Agonoderus pallipes	1
Anisodactylus sp	1
Unidentified Carabidae	21
Haliplus ruficollis	1
Haliplus connexus	1
Haliplus sp	3
Peltodytes callosus	1
Peltodytes 12-punctatus	1
Peltodytes edentulus	1
Coelambus sp	1
Hydroporus sp	1
Agabus sp	1
Colymbetes sculptilis	1
Colymbetes sp	1
Dytiscid larvae	2
Unidentified Dytiscidae	7
Unidentified Gyrinidae	1
Tropisternus sp	5
Hydrocharis obtusatus	1
Berosus sp	2
Hydrobius globosa	1
Hydrobius fuscipes	1
Unidentified Hydrophilidae	5

TABLE 1.—*Items of animal food identified in stomachs of the horned grebe, with the number of times that each occurred*—Continued.

COLEOPTERA—Continued.	
Staphylinid larvae	1
Unidentified Staphylinidae	1
Saprinus sp	1
Unidentified Nitidulidae	1
Heterocerus sp	1
Unidentified Elateridae	1
Unidentified Buprestidae	1
Aphodius inquinatus	6
Aphodius sp	2
Unidentified Cerambycidae	1
Donacia sp	1
Unidentified Chrysomelidae	1
Unidentified Curculionidae	1
Tomicus sp	1
Unidentified Rhynchophora	4
DIPTERA (Flies).	
Chironomid larvae	2
Larval *Tabanus* sp	1
Unidentified Muscidae	1
HYMENOPTERA (Wasps, Bees, and Ants).	
Campoplex sp	1
Phaeogenes sp	1
Camponotus herculeanus	1
Camponotus sp	1
HYMENOPTERA—Continued.	
Unidentified ants	4
Tiphia inornata	1
Chloralictus sp	1
Ceratina dupla	1
Unidentified hymenopterans	4
ARACHNIDA (Spiders, etc.).	
Unidentified spiders	3
MOLLUSCA (Snails, Mussels, etc.).	
Unidentified snail	1
PISCES (Fishes).	
Cyprinus carpio	1
Unidentified Cyprinidae	1
Anguilla sp	1
Stolephorus sp	1
Gasterosteus cataphractus	2
Menidia sp	1
Unidentified Percoidea	1
Boleosoma olmstedi	2
Chitonotus pugetensis	1
Cottus sp	6
Unidentified Cottidae	1

EARED GREBE.

(*Colymbus nigricollis californicus.*)

The American form, or subspecies, of the eared grebe is confined to the western part of North America, where it breeds from central and southern Canada south to California, Arizona, New Mexico, and northern Iowa. In winter it passes south to Lower California and Guatemala. In breeding plumage the eared grebe has a distinct crest that distinguishes it at once from the horned grebe, but during fall and winter the two are very similar in color. At this season the eared grebe may be told by its distinctly smaller size and by the form of the bill, which is flattened so that it is broader at the base than it is high. In the horned grebe the bill is laterally compressed, so that the width is less than the height.

Eared grebes are seen commonly on open water even during the breeding season and, on the whole, are less timid than other grebes. They nest in large colonies on shallow lakes where there is suitable cover of rushes growing in the water. During the mating season the birds are found in pairs and have many courtship antics of interest. At this season they call constantly with pleasing whistled notes which at night blend with the voices of other marsh birds to form a wild chorus.

In winter eared grebes are found on salt water along the Pacific coast. They are common also during migration in the strongly saline waters of Great Salt Lake, where they are attracted by the multitudinous brine shrimps (*Artemia*) that swarm in many bays. Because of the density of the water the birds seem to rest lightly on the surface and after diving bob up like corks. On a few occasions eared grebes, attracted by innumerable larvae of alkali flies, have lingered on Owens Lake, Calif., another saline lake, until thousands, poisoned by the concentrated alkalis in the water, have become weakened and died. Their bodies drift ashore and are cast up in wind-

rows, together with the puparia of the almost incredibly numerous alkali flies (*Ephydra*). Formerly the eared grebe was killed by thousands by the plume hunters for the thick, satiny breast feathers. Fortunately for the continuance of the species, this is now prohibited.

FOOD.

For a survey of the food of the eared grebe 27 stomachs were available from many localities in the Western States. In this series three months—January, February, and August—were not represented. Vegetable matter had been taken by two birds, but was present in such small quantity that it did not figure in the percentages. Animal food may therefore be considered as making up 100 per cent, disregarding, as in the other species of grebes treated, the presence of feathers. In one case the vegetable matter consisted of a seed of a *Polygonum*, and in the other of matter that may be classed only as vegetable rubbish. Feathers were present in less quantity than in the stomachs of the other species of grebes examined, as this item amounted to only 27 per cent.

In only 5 of the 27 stomachs examined were remains of fishes encountered, or in less than one-fifth of the total. One bird killed near Portland, Oreg., had eaten a small sculpin (family Cottidae), while in four others the fish remains were identified merely as those of small bony fishes. These amount to only 9.8 per cent of the total food.

The insect food of the eared grebe was abundant and varied. Heteroptera alone amounted to 40 per cent, and had been eaten by 13 of the birds examined. Except for one bug of the family Reduviidae, these were all aquatic species. Water boatmen (Corixidae) were most abundant and had been taken by 11 birds, in one of which they totaled more than 1,300 individuals. Among other forms water bugs (*Belostoma*) and back-swimmers (*Notonecta*) were taken.

Dragonflies and damselflies were eaten by 8 birds and amounted to 19.5 per cent. They consisted mainly of nymphs. Beetles, mainly water-dwelling forms, were eaten by 12 birds and amounted to 14.3 per cent of the total. The crawling water beetles (Haliplidae), though of small size were well represented, as 3 species were definitely identified. Following these come many predacious diving-beetles (Dytiscidae) and water scavenger-beetles (Hydrophilidae). Rove beetles (in one case *Philonthus fusiformis*) and click beetles (Elateridae) also were taken. Leaf beetles (among them *Myochrous squamosus*, *M. longulus*, and a *Diabrotica*) were found 4 times and weevils 4 times. Larval forms of beetles as well as adults were encountered frequently. Larvae of ground beetles (Carabidae) were taken once, the immature forms of predacious diving beetles 4 times, and larvae of water scavenger beetles once. Miscellaneous insects of other groups amounted to 10.9 per cent. Caddisfly larvae were found in two stomachs and a grasshopper in one. Caterpillars of a moth (Pyralidae) were eaten twice, and remains of other Lepidoptera were found twice, as also were remains of Diptera and Hymenoptera. Miscellaneous animal matter, taken by 9 birds and amounting to 5.5 per cent, completes the tale of food in the material examined. In this material were found a centipede, 2 spiders, an

aquatic mite, and a snail (*Planorbis*); remains of a marine worm (*Nereis*) and of a frog; and, representing the group of crustaceans, an amphipod (*Gammarus*), an opossum shrimp (*Neomysis*), and 2 unidentified forms.

In the field the writer has observed eared grebes swimming about in pursuit of alkali flies (Ephydridae) that rested lightly on the surface film of the water. As they came within reach they were seized with an almost unerring thrust of the bill. On Lake Burford, northern New Mexico, at dusk the birds gather in flocks on a broad open expanse to secure the ants and beetles, which, flying out from the sage-grown hills surrounding the lake, are entrapped and drowned in the water. Gnats (Chironomidae) and Mayflies that emerge in myriads from the water also furnish an eagerly sought supply of food. Insects drifting in the water form a favorite source of subsistence with these birds and are often intermingled with living prey. The tireless activity of these grebes in feeding is shown by the stomach contents of one bird secured in Montana at the end of May. This one individual had eaten 315 weevils (*Hyperodes*), 650 water scavenger-beetles of one genus (*Berosus*) and 52 belonging to three or more other genera, 42 leaf beetles (*Myochrous squamosus*), 2 billbugs (*Sphenophorus*), 3 rove beetles, 6 ground beetles with two larvae belonging to the same family, 61 caterpillars, 1 bug, 2 centipedes, and 3 or more spiders, a total of at least 1,139 individuals.

SUMMARY.

From this detailed enumeration of the food of the eared grebe it appears that the species is harmless to human interests. The fishes taken are few in number and apparently of little or no economic value. Insects form a greater proportion of the food than in the three preceding species, but have little economic significance. A considerable number of dragonfly nymphs are eaten, but these are destructive of small fishes, though adult dragonflies are valuable as enemies of mosquitoes. Like the horned grebe, the present species picks up many dead insects that are drifting about on the surface of the water. Like its larger cousin, the western grebe, this grebe was formerly killed in large numbers for its plumage, but fortunately laws and fashions changed in time to prevent its extermination. There is no longer danger of a recurrence of this slaughter, as the killing of the eared grebe is now prohibited by law, a protection that is well merited on account of the bird's harmlessness in its choice of food.

TABLE 2.—*Items of animal food identified in stomachs of the eared grebe, with the number of times that each occurred.*

ANNULATA (Worms).	
Nereis sp.	1
AMPHIPODA (Shrimplets).	
Gammarus sp.	1
SCHIZOPODA (Opossum Shrimps).	
Neomysis sp.	1
Unidentified crustaceans	2
ZYGOPTERA (Damselflies).	
Unidentified damselflies	1
ANISOPTERA (Dragonflies).	
Libellulid nymph	1
Unidentified nymph	1
ORTHOPTERA (Grasshoppers, etc.).	
Unidentified grasshopper	1

TABLE 2.—*Items of animal food identified in stomachs of the eared grebe, with the number of times that each occurred*—Continued.

HETEROPTERA (Bugs).	
Unidentified Reduviidae	1
Belostoma sp	1
Notonecta sp	1
Unidentified Corixidae	11
PHRYGANOIDEA (Caddisflies).	
Unidentified caddisfly larvae	2
LEPIDOPTERA (Moths and Butterflies).	
Pyralid caterpillars	2
Unidentified caterpillar	1
Unidentified pupa	1
COLEOPTERA (Beetles).	
Bembidium sp	2
Amara sp	2
Unidentified carabid larva	1
Unidentified Carabidae	4
Haliplus cribrarius	1
Haliplus longulus	1
Haliplus sp	2
Peltodytes callosus	1
Unidentified Haliplidae	1
Coelambus inaequalis	1
Coelambus patruelis	1
Deronectes griseostriatus	1
Rhantus binotatus	1
Colymbetes sp	1
Acilius sp	1
Unidentified dytiscid larvae	4
Unidentified Dytiscidae	2
Gyrinus sp	1
Helophorus sp	2
Tropisternus sp	1
Berosus striatus	2
Berosus sp	2
Philhydrus hamiltoni	1
Philhydrus sp	1
Unidentified hydrophilid larva	1
Unidentified Hydrophilidae	1
Philonthus fusiformis	1
Unidentified Staphylinidae	1
COLEOPTERA—Continued.	
Monocrepidius vespertinus	1
Monocrepidius sp	1
Myochrous longulus	1
Myochrous squamosus	2
Diabrotica sp	1
Hyperodes sp	2
Unidentified Curculionidae	1
Sphenophorus sp	1
DIPTERA (Flies).	
Unidentified stratiomyid larva	1
Unidentified dipterous larva	1
Unidentified Diptera	1
HYMENOPTERA (Wasps, Bees, and Ants).	
Ichneumonidae	1
Ants	1
CHILOPODA (Centipedes).	
Unidentified centipede	1
ARANEIDA (Spiders).	
Unidentified spiders	2
ACARIDA (Mites).	
Unidentified aquatic mite	1
MOLLUSCA (Snails, Mussels, etc.)	
Planorbis sp	1
PISCES (Fishes).	
Unidentified Cottidae	1
Unidentified fishes	4
AMPHIBIA (Frogs, Toads, and Salamanders).	
Frog	1

MEXICAN GREBE.

(*Colymbus dominicus brachypterus.*)

The Mexican grebe, the smallest representative of its family found in North America, is fairly common in favorable localities in southern Texas, but is not known to occur elsewhere in the United States. In the lower Rio Grande Valley, near Brownsville, it is reported to nest in fair numbers and may be resident throughout the year.

In general habits this bird is said to resemble other grebes. It is found in small ponds and lakes where there is proper concealment furnished by growths of cat-tails, rushes, and sedges.

Philip Gosse[4] records that the stomachs of birds killed by him were filled with a finely ground substance which, from his description, appears to have been feather remains, so that it would seem that the Mexican grebe shares the feather-eating habit of its relatives. No other references to the food of the Mexican grebe have been found in literature, and as there are no stomachs of this species at hand for examination, no further data are available in regard to its economic status. It is probable that the bird lives largely upon

[4] Birds of Jamaica, p. 443, 1847.

aquatic insects, but this statement must not be accepted as fact, as it is based entirely upon knowledge of the feeding habits of other species.

PIED-BILLED GREBE.

(*Podilymbus podiceps.*)

The pied-billed grebe, the most widely distributed species of its family occurring in the United States, ranges over most of North and South America where suitable conditions are found. In North America it breeds as far north as Canada, though in the southern part of the United States it is often local in distribution. While

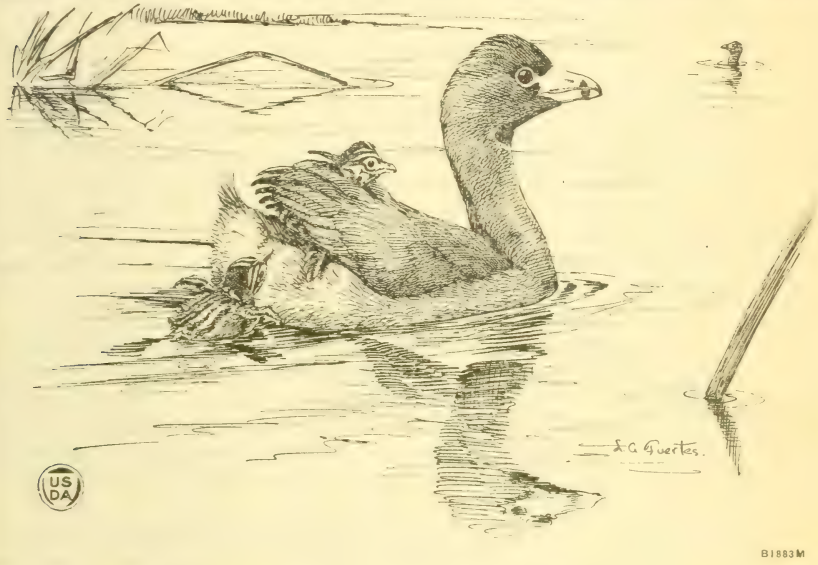

FIG. 4.—Pied-billed grebe.

not so hardy as some of the species of more typically Boreal habitat, yet during the winter months it occurs to some extent in the United States.

The pied-billed grebe is known familiarly to every country boy, as it appears regularly on ponds and slow-running streams and is not restricted to the larger lakes and watercourses, as is usual with other grebes. The marvelous facility that grebes exhibit in diving is well shown in the present species, and this habit has become legend, associated with the name "hell-diver."

At all times pied-billed grebes are birds of fresh-water habit, and though they may occur in river mouths and lagoons where the influence of the tide is felt, it is exceptional to see them on salt water. In summer they haunt ponds and streams bordered with cat-tails and tules, and in the seclusion of these growths conceal their nest, a mass of vegetation piled up in shallow water as a platform that barely projects above the surface. The strange cadenced calls of the males come regularly from the rushes, but the birds remain

hidden, so that few persons are familiar with the true source of these notes. Even during the breeding season these birds are more solitary in habit than other grebes. The males are savage fighters, so that even coots, recognized bullies of the marsh, treat them with marked respect.

The short, strong bill, higher than wide, and with a dark bar, serves to distinguish the pied-billed grebe from our other species. (See fig. 4.) The plumage in general is dark dull brown, blacker above, somewhat brighter on the breast, and nearly white on the abdomen. In breeding plumage both sexes have a jet black throat patch which is lacking during the winter season. After the nesting season and the molt of feathers that follows it, these grebes leave their secluded haunts and appear more often in the open.

FOOD.

As the pied-billed grebe is common and widely distributed, it has been possible to secure abundant material for the study of its food, in spite of its reputed immunity to the weapons employed by the hunter. In the present studies 180 stomachs of these birds have been available for examination. The feather content of these (an almost invariable constituent in stomachs of grebes) reached 52.5 per cent, or slightly more than one-half. As in the preceding forms, this was disregarded in estimating the total food, and the remaining items were apportioned on the basis of 100 per cent.

Six stomachs contained feathers alone, leaving 174 available for a résumé of the food. The sustenance of the pied-billed grebe is taken almost entirely from the animal kingdom. In the present series only 3 birds had secured small quantities of vegetable matter, so that the presence of such substances may be considered as accidental. These were made up of rubbish in two instances and of a single seed (*Nymphaea*) in the third.

Of the total food, 24.2 per cent was made up of fishes of a variety of species. Among these, catfishes occurred 3 times, in one case the remains being those of a channel cat (*Ictalurus punctatus*) and in two others those of bullheads (*Ameiurus*). It was interesting to note that the thorny pectoral and dorsal spines of the channel cat had been broken, apparently before the fish had been swallowed. A small sucker (*Catostomus commersoni*) had been eaten by one bird and a chub (*Leuciscus*) by another. The bream (*Abramis chrysoleucus*) was taken twice, and remains of carp (*Cyprinus carpio*) were found 5 times. Where carp are abundant, numbers may be eaten at one meal. Thus, of 2 birds taken on the lower course of Bear River, Utah, one had secured 8 and the other 17 small carp. Unidentified fishes belonging to the carp family (Cyprinidae) were taken in two cases. An eel (*Anguilla chrysypa*) was found once, and killifishes (Poeciliidae) 7 times—in 6 cases identified as top minnows (*Fundulus*). A silverfish (*Kirtlandia*), one of the small forms commonly known as "shiner," was eaten by one bird. Sunfishes seemed relished also, as the common sunfish (*Eupomotis gibbosus*) was taken once, sunfishes of another genus (*Lepomis*) 6 times, and unidentified forms belonging to the sunfish family (Centrarchidae) 6 times. Members of the family of perches (Percidae) were taken twice. One bird had eaten a miller's-thumb (*Cottus*

ictalops) and another fresh-water sculpin belonging to the same genus. Other bony fishes that could not be identified were found in 36 stomachs.

In all, fish remains were encountered in 69 of the 174 stomachs. The catfishes, eel, perches, and part of the sunfishes taken may be considered valuable; the others have little importance. A part of the latter, as the sucker and carp, are used by man, but are not considered first-class food fishes. The majority of the unidentified bony fishes were undoubtedly minnows of no value except as food for other animals of larger size. Fishes were eaten only in small quantities from May to August, inclusive, when the birds were on their nesting grounds, but formed a considerable part of the food at other seasons.

The crawfishes eaten by these birds amount to 27 per cent of the total food. They occurred less commonly in birds taken in November than at other seasons. Common eastern forms (*Cambarus*) were taken in 44 instances, and western ones (*Potamobius*) in 6. Crawfishes 3½ inches long often were found and from their appearance and position in the stomach had been swallowed tail foremost. In the larger individuals the claws had been sheared off near the body before the animals were swallowed. The larger eastern crawfishes sometimes do serious damage in cultivated fields, where they destroy young plants or in some cases cause trouble by throwing out mud "chimneys." At times they also cause breaks in the dams of artificial ponds by boring holes through them.

Other crustaceans amount to 4.1 per cent of the food for the year. They were taken in December, January, and February and consist of shrimps (*Crago*), prawns (*Palaemonetes*), and fiddler crabs (*Uca*). Unidentified crustaceans were found 9 times and may in part be fragments of crawfishes too far digested to be recognized.

The insect portion of the food made up 46.3 per cent of the whole. Heteroptera (bugs), Coleoptera (beetles), and the groups containing the dragonflies and damselflies were best represented. Heteroptera alone made up 16.2 per cent of the food and were rather evenly distributed throughout the year. The true water bugs, predatory species, were especially well represented, and members of this family (the Belostomidae) were found in 32 stomachs, in 25 of which there were remains of the large species belonging to the genus *Belostoma*, which contains the familiar giant water-bug, or "electric-light bug." These are predacious and are highly destructive to young fry of fishes as well as to other aquatic life, so that in the evident predilection of this grebe for them the bird is rendering good service. Back-swimmers (*Notonecta*) were taken 13 times, and water boatmen (Corixidae) 26 times. Four common eastern water-creepers (*Pelocoris femoratus*), a species that feeds on other insects, were encountered, and one water scorpion (*Ranatra*), a curious long-bodied form that is also predatory. Heteroptera as a whole were noted in 68 of the stomachs examined.

Coleoptera were found about as often as Heteroptera in the food of the pied-billed grebe, as they formed 16.1 per cent of the total and were found in 93 stomachs. The majority of these were aquatic species of fair size, evidently secured by direct chase. The pied-billed grebe apparently is more active in pursuit of prey than the

horned or eared grebes, and only occasionally is there evidence that it resorts to dead insects floating on the water as a source of food. The crawling water-beetles seem too small to attract much attention from this bird, as they were encountered only 5 times. Adult predacious diving beetles were favored in this group, especially those species of moderate or large size. The larvae of these beetles were encountered in only one instance, but adults of various forms were identified no fewer than 76 times.

The active whirligig beetles (Gyrinidae) also figure to a somewhat surprising degree in the food, being identified 16 times. These are probably secured by diving, as they seem less erratic in their movements when submerged than when on the surface. Water scavenger-beetles (Hydrophilidae) were less favored, occurring only 13 times. The enumeration above is in striking contrast with that in the case of the horned and eared grebes, where Hydrophilidae and miscellaneous beetles, secured when dead, figured so prominently. In the case of the present species beetles other than aquatic were taken rarely, as is shown in Table 3, following this section.

Remains of dragonflies and damselflies amount to 8 per cent and were eaten during the warmer months from May to October, inclusive. In July and August these insects form a considerable part of the food, as in 19 stomachs representing these two months their remains amount to 34 per cent. The greater part were nymphs of dragonflies, as damselflies figured in the food of only one bird.

Miscellaneous insects of other groups amounted to 2.3 per cent. They were made up of remains of grasshoppers and caterpillars in one instance, the puparia and larvae of flies in three, and some miscellaneous fragments of Hymenoptera. The dipterous remains are those of aquatic species easily obtained by a diving bird. The others may well have been floating about on the water, where they were picked up at random.

Other miscellaneous animals of a variety of forms, but not eaten frequently, amounted to 2.1 per cent. Spiders were taken 3 times, marsh snails (*Physa* and *Limnaea*) once, other aquatic snails not certainly identified 3 times, and small frogs 5 times.

SUMMARY.

Though nearly one-fourth of the food of the pied-billed grebe is made up of fishes, the majority of those taken belong to species of slight economic importance. Those of value are compensated for by the large number of crawfishes destroyed, as in bulk these amount to more than the fishes taken. Aquatic Heteroptera and Coleoptera also are favored and together comprise one-third of the diet. Predacious species in both groups are well represented, some of them being of sufficient size to prey upon fish fry. In eating these, therefore, the grebe more than compensates for the fishes consumed.

Complaint is made of pied-billed grebes around fish hatcheries. There they may do considerable harm, though the evidence at hand shows that even in such localities they seem to take many water bugs and crawfishes, all of injurious habits. Grebes, however, will not confine their attention to this kind of food, and when they appear on the ponds and it is not possible to drive them away they should

be killed if Federal and State laws permit.[5] Under ordinary conditions, however, pied-billed grebes should not be molested. They are not game birds and are not used for food, so that as a matter of fact they are seldom molested except by persons who, unacquainted with them, kill one occasionally through curiosity.

TABLE 3.—*Items of animal food identified in stomachs of the pied-billed grebe, with the number of times that each occurred.*

PHYLLOPODA (Brine Shrimps, etc.).	
Artemia sp	1
DECAPODA (Crabs, Shrimps, etc.).	
Crago sp	1
Palaemonetes sp	1
Cambarus sp	44
Potamobius sp	6
Uca sp	1
Unidentified crustaceans	9
ZYGOPTERA (Damselflies).	
Unidentified nymph	1
ANISOPTERA (Dragonflies).	
Unidentified libellulid nymph	1
Unidentified aeschnid nymph	1
Unidentified dragonfly nymphs	9
Unidentified dragonfly	2
ORTHOPTERA (Grasshoppers, etc.).	
Unidentified Acrididae	1
Unidentified Locustidae	1
Unidentified Orthoptera	1
HETEROPTERA (Bugs).	
Pelocoris femoratus	4
Belostoma sp	6
Nymphs of *Belostoma* sp	19
Unidentified Belostomidae	7
Ranatra sp	1
Notonecta sp	13
Unidentified Corixide	26
Unidentified Pentatomidae	1
LEPIDOPTERA (Moths and Butterflies).	
Unidentified caterpillar	1
COLEOPTERA (Beetles).	
Pterostichus sp	1
Unidentified Carabidae	4
Haliplus fasciatus	1
Peltodytes callosus	1
Peltodytes muticus	1
Unidentified Haliplidae	2
Colpius inflatus	1
Coelambus sp	1
Rhantus tostus	1
Colymbetes sp	11
Dytiscus sp	4
Cybister fimbriolatus	1
Unidentified dytiscid larva	1
Unidentified Dytiscidae	56
Dineutes sp	10
COLEOPTERA—Continued.	
Unidentified Gyrinidae	6
Tropisternus sp	3
Hydrophilus triangularis	2
Berosus sp	2
Unidentified Hydrophilidae	6
Ligyrus relictus	1
Donacia sp	2
Balaninus sp	1
Unidentified Curculionidae	3
Sphenophorus costipennis	1
Sphenophorus sp	1
DIPTERA (Flies).	
Unidentified chironomid larva	1
Unidentified chironomid pupa	1
Unidentified stratiomyid larva	1
HYMENOPTERA (Wasps, Bees, and Ants)	
Unidentified Camponotidae	1
Unidentified Diapriidae	1
Unidentified Chalcidoidea	1
ARANEIDA (Spiders).	
Unidentified spiders	3
MOLLUSCA (Snails, Mussels, etc.).	
Limnaea sp	1
Physa sp	1
Unidentified snails	3
PISCES (Fishes).	
Ictalurus punctatus	1
Ameiurus sp	2
Catostomus commersoni	1
Leuciscus sp	1
Abramis chrysoleucus	2
Cyprinus carpio	5
Unidentified Cyprinidae	2
Anguilla chrysypa	1
Fundulus sp	6
Unidentified Poeciliidae	1
Kirtlandia sp	1
Lepomis sp	6
Eupomotis gibbosus	1
Unidentified Centrarchidae	6
Unidentified Percidae	2
Cottus ictalops	1
Cottus sp	1
Unidentified fishes	36
AMPHIBIA (Frogs, Toads, and Salamanders).	
Rana sp	4
Unidentified anuran	1

[5] See footnote No. 2, p. 3.

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